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ABSTRACT

One of a set of six guides for an industrial arts curriculum at the junior high school level, this guide provides the basic foundation to develop a one-semester course based on the cluster concept, construction technology. The guide suggests activity-oriented classroom and laboratory instruction focusing on the technical, environmental, safety, and career aspects of the construction field. Following an introduction covering rationale, cluster outline and objectives, and cluster taxonomic structure, four units are presented: introduction to construction technology, preconstruction, construction, and postconstruction. Each unit includes unit objectives, student competencies and related student activities, and where applicable, illustrations, laboratory activities, and a listing of equipment and supplies needed. A bibliography of films and books, and a listing of teaching aids and special equipment are appended. (SH)

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ED147463

INDUSTRIAL ARTS

CONSTRUCTION TECHNOLOGY

Curriculum Guide

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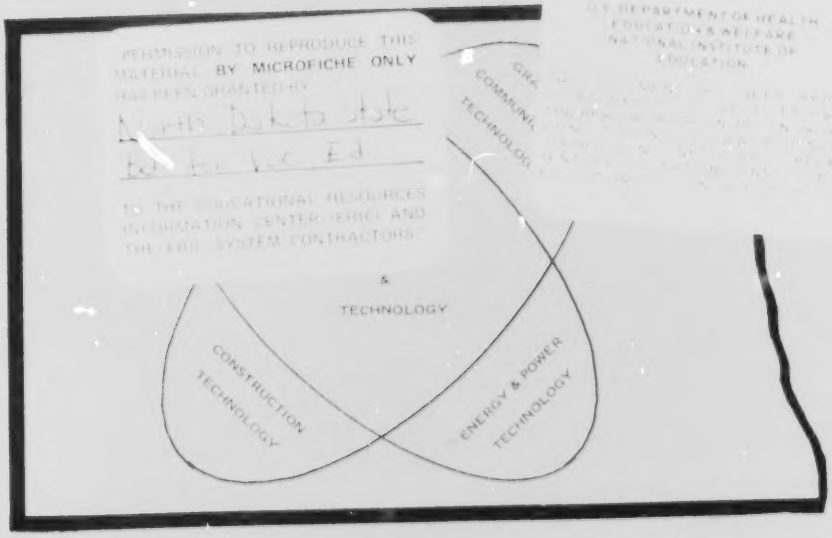

NORTH DAKOTA

NORTH DAKOTA STATE BOARD FOR
VOCATIONAL EDUCATION
Bismarck, North Dakota

CE 012 457

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CONSTRUCTION TECHNOLOGY

RATIONALE: The development of the Construction Technology cluster has evolved from the industrial technology body of knowledge.

The purpose of studies of this construction technology cluster is to provide students, through activity-oriented instruction, with; the broad context of the construction industry; selected practices in pre-construction, construction and post-construction. Studies within this cluster are complimented by student conducted laboratory activities which emphasize the technical aspects, environmental, safety, and career aspects of this cluster.

More specifically, the educational purposes of this instructional cluster are to provide students with:

1. The broad concept of construction technology within the context of the industrial technology.
2. Selected practices in pre-construction.
3. An understanding of construction activity and utilization of tools and materials.
4. An application of the construction methods.
5. The significance of self-realization and self-activating behaviors for future learning in professional or technical fields.

OBJECTIVES: Primary objectives of Construction Technology are to:

1. Place Construction Technology in the broad context of industrial technology.
2. Provide selected Construction Technology activities for the

development of attitudes, appreciation, and understanding in an introduction to construction, pre-construction, construction, and post-construction.

3. Develop an awareness of self-realization and generate self-activating behaviors.
4. Develop an understanding of construction activities and the tools and materials utilized in their construction.
5. Relate the activities of construction technology to local, state, and national developments.
6. Utilize knowledge of past, present and future techniques outside the classroom.

CONSTRUCTION TECHNOLOGY

GUIDELINES FOR IMPLEMENTATION

This eighteen week course is designed to provide students with an opportunity to better understand Construction Technology within the broader context of industrial technology, and to provide educational, technical, and professional guidance. It provides the student with learning experiences related to construction concepts; the introduction to construction, pre-construction, construction, and post-construction stages. The learning experiences are for all students.

While this course is designed for one semester, it can be expanded by following enrichment lessons from the World of Construction or teacher developed units. It can be shortened by omitting certain units and activities. There are no rigid time schedules, so the teacher can determine the pace. The teacher can also teach other units that have demonstrated to be meaningful in previous classes by integrating each unit or replacing any unit in this course.

Any one of the following texts may be selected as the primary textbook. It should be noted that this curriculum guide is based upon the text Construction by Landers, for the first major unit, Introduction to Construction Technology and The World of Construction for the remaining three major units. Furthermore, it is well to recognize that the Exploring the Construction Industry text is a recent publication and may serve as a substitute to The World of Construction text.

TEXTBOOK(S)

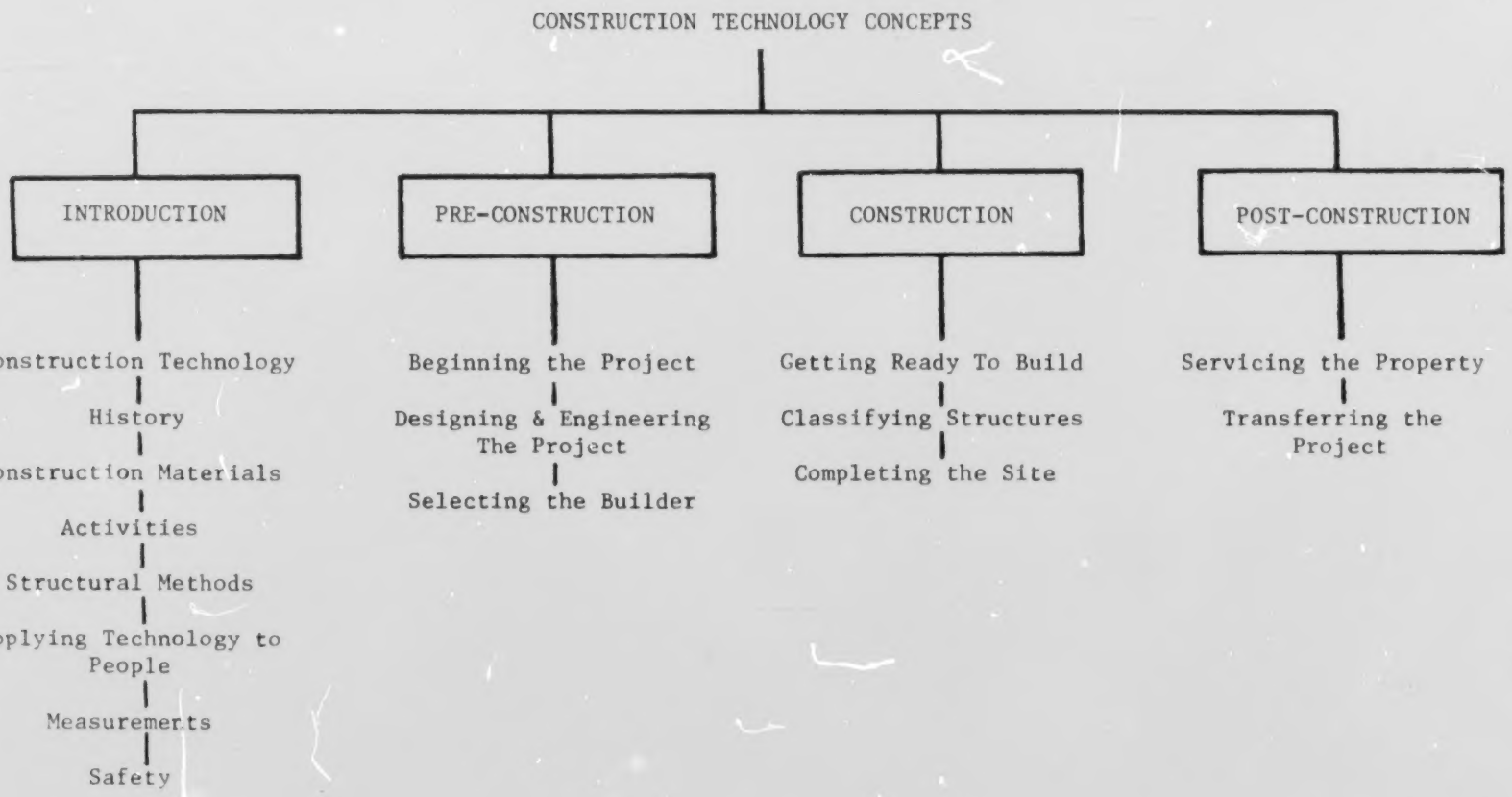
The World of Construction; Teacher's Edition, student textbook and student laboratory manual, McKnight and McKnight Publishing Co., Bloomington Illinois.

Exploring the Construction Industry; Teacher's Edition, student textbook, and student activity booklet, McKnight and McKnight Publishing Co., Bloomington, Illinois.

Landers, Jack M., Construction Materials, Methods, and Careers, Goodheart and Wilcox Publishing Co., Inc., Chicago, Illinois, 1976.

Landers, Jack M., Construction Laboratory Manual, Goodheart and Wilcox Publishing Co., Inc., Bloomington, Illinois.

TAXONOMETRIC STRUCTURE



CONSTRUCTION TECHNOLOGY

BODY OF KNOWLEDGE

1.00 INTRODUCTION TO CONSTRUCTION TECHNOLOGY

- 1.10 Construction Technology
  - 1.11 Construction management
  - 1.12 Construction personnel
  - 1.13 Construction processes
  - 1.14 Construction materials
- 1.20 History of Building Construction
  - 1.21 Development of architectural styles
  - 1.22 Post and lintel
  - 1.23 Arch
  - 1.24 Vault
  - 1.25 Dome
  - 1.26 Truss
  - 1.27 Frame
- 1.30 Construction Materials
  - 1.31 Concrete
  - 1.32 Metal
  - 1.33 Wood
  - 1.34 Synthetics
- 1.40 Applying Construction Technology to People
  - 1.41 Construction technology careers
  - 1.42 Advancing in construction
- 1.50 Construction Technology and the International System of Measurement
  - 1.51 Introduction to measurement
  - 1.52 Measurement in the U.S.
  - 1.53 Systems International units of measure
  - 1.54 Seven base units
    - 1.741 Derived units
    - 1.742 Supplemental units
    - 1.743 Non-SI units
  - 1.55 Prefixes
    - 1.751 Using the prefixes
  - 1.56 Drawing to scale
  - 1.57 SI scales for construction and map drawing
  - 1.58 Useful conversions
- 1.60 Construction Technology and Safety
  - 1.61 Introduction to safety
  - 1.62 Personal protective equipment
    - 1.621 Hard hat
    - 1.622 Foot wear

1.623 Hearing devices
1.624 Eye shields
1.625 Dust respirators
1.626 Work gloves
1.627 Protection against falling

1.63 Scaffolds

2.00 PRE-CONSTRUCTION

2.10 Beginning the Project
2.11 Selecting the site
2.12 Buying real estate
2.13 Surveying and mapping
2.14 Soil testing

2.20 Designing and Engineering the Project
2.21 Identifying design problems
2.22 Analyzing the design
2.23 Designing and engineering cycle
2.24 Energy usage, conservation and ramifications related to construction

2.30 Selecting the Builder
2.31 Contracting
2.32 Estimating and bidding
2.33 Scheduling

3.00 CONSTRUCTION

3.10 Getting Ready to Build
3.11 Clearing the site
3.12 Locating the structure
3.13 Earth moving
3.14 Stabilizing earth and structures

3.20 Classifying Structures
3.21 Setting foundations
3.22 Building forms
3.23 Setting reinforcements
3.24 Mixing concrete
3.25 Placing and finishing concrete
3.26 Completing foundations
3.27 Building super structures
3.28 Building mass and masonary super structures
3.29 Building wood frames
3.210 Installing utilities
3.211 Enclosing framed super structures
3.212 Finishing the project

3.30 Completing the Site

4.00 POST-CONSTRUCTION

4.10 Servicing the Property

4.20 Transferring the Project

CONSTRUCTION TECHNOLOGY

MAJOR UNITS

1.00 INTRODUCTION TO CONSTRUCTION TECHNOLOGY . . . . . 10 Days

2.00 PRE-CONSTRUCTION . . . . . 15 Days

3.00 CONSTRUCTION . . . . . 60 Days

4.00 POST-CONSTRUCTION . . . . . 5 Days

UNIT I

1.00 INTRODUCTION TO CONSTRUCTION TECHNOLOGY 10 Days

OBJECTIVE: To provide the student with a broad concept of construction technology within the context of industrial technology.

UNIT OUTLINES AND OBJECTIVES

1.10 Construction Technology

1.11 Construction management

1.12 Construction personnel

OBJECTIVES: At the end of this unit-unit, the student will be able to:

1. Relate construction to the broad range of human activities.
2. Explain how workers, materials, and processes get the job done right and on time.
3. Discuss procedures which cover recruiting, interviewing, and hiring practices.
4. Cite the need for education and training both before and after entering the field of construction.

1.20 History of Building Construction

1.21 Development of architectural styles

1.22 Post and lintel

1.23 Arch

1.24 Vault

1.25 Dome

1.26 Truss

1.27 Frame

OBJECTIVES: At the end of this sub-unit, the student will be able to:

1. Give a brief history of the development of architectural styles.
2. Identify the post and lintel, arch and truss as a structural system.

1.30 Construction Materials

1.31 Concrete

1.32 Metal

1.33 Wood

1.34 Synthetics

OBJECTIVES: To provide the student with a knowledge of construction materials and products over the broad area of construction technology to include a range from stone and sand to concrete blocks and chemical compounds, and from paper and synthetics to wood and metal as standardized materials.

1.40 Applying Construction Technology to People

1.41 Construction technology careers

1.42 Advancing in construction

OBJECTIVES: The student will be able to:

1. Identify some of the responsibilities a contractor has other than making sure the correct materials are used.

2. Name which of the following groups, in a contractors office, you would choose to work in and explain why you chose it:

   a) Administrative

   b) Engineering

   c) Construction

1.50 Construction Technology and the International System of Measurement

1.51 Introduction to measurement

1.52 Measurement in the U.S.

1.53 Systems International units of measure

1.531 Derived units

1.532 Supplemental units

1.533 Non-SI units

1.54 Prefixes

1.541 Using the prefixes

1.55 Drawing to scale

1.56 SI scales for construction and map drawing

1.57 Useful conversions

OBJECTIVES: The student will be able to:

1. Recognize the International SI Metric System of Measurement.
2. Give a brief history of the metric form of measurement.
3. Give the basis for the U.S. change over to metric.
4. Give an explanation of the seven base units and the common derived units of area and volume.

5. Give an explanation of the use of prefixes.

6. Give a showing of the basic manipulative concepts of base temperature.

1.60 Construction Technology and Safety

1.61 Introduction to safety

1.62 Personal protective equipment

1.621 Hard hat

1.622 Foot wear

1.623 Hearing devices

1.624 Eye shields

1.625 Dust respirators

1.626 Work gloves

1.627 Protection against falling

1.63 Scaffolds

OBJECTIVES: The student will be able to:

1. List safety practices related awareness

2. List potential harmful and hazardous conditions, to health and environment.

3. Know the significance of the Williams-Steger Act, better known as the Occupational Safety and Health Act (OSHA).

4. List personal protective equipment.

Text: Landers, Jack M., CONSTRUCTION MATERIALS, METHODS, AND CAREERS, Goodheart and Wilcox Publishing Co., Inc., Chicago, Illinois, 1976.

Landers, Jack M., CONSTRUCTION LABORATORY MANUAL, Goodheart and Wilcox Publishing Co., Inc., Bloomington, Illinois.

UNIT NO. I	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
1.00	INTRODUCTION TO CONSTRUCTION TECHNOLOGY THE STUDENT WILL BE ABLE TO:	
1.10	A. Give advantages of organization vs no organization.	A1. Divide the class in groups of five each holding a defined position. A2. Hand out class organization practice sheets (Fig. 4.2, Jack M. Landers, Construction Instructor's Guide and Key, Page 10).
	B. Recite the qualifications and duties of: 1. Shop Foreman 2. Recorder 3. Equipment Supervisor 4. Supply Clerk 5. Safety-grievance person	B1. Allow each group to choose its five positions. B2. Have class fill out class organization chart. B3. Orally quiz the individuals about their new role in construction organization.
1.20	A. Identify the post and lintel, arch and truss as a structural system.	A1. Assemble the post and lintel model, assemble blocks to form an arch, and assemble the truss section.
	B. Describe the effects of a downward force on the post and lintel, arch and truss systems.	B1. Observe that weaker material used for the lintel requires that posts be set close together.
	C. Identify the nature of supporting loads inherent in building.	C1. Observe that the arch will withstand downward thrust only equal to the massive weight of the supporting posts, and observe that the truss is a very stable design.

UNIT NO.	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
1.60	A. List safety practices related awareness.	A1. Discuss the kinds of attitudinal developments required to work safely in construction.
	B. List potential harmful and hazardous conditions to health and environment.	B1. In the community, observe and identify potential unsafe conditions to health and environment.
	C. Know the significance of the Williams-Steger Act, better known as the Occupational Safety and Health Act (OSHA).	C1. Discuss the significance of OSHA.
	D. List personal protective equipment.	D1. Observe careless practices regarding the use of personal protective equipment.

UNIT NO.	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
1.30	A. Identify a variety of construction materials.	A1. Students should learn the characteristics of materials through a systematic manner, for the purposes of identification and recognizing qualities enherent in each kind of material.
	B. Recognize construction materials in their standard form	B1. Students should obtain samples of each kind of construction material in their standard form.
1.40	A. Choose a technical career or professional position.	A1. Identify the technical or professional area you've chosen.
	B. Find the appropriate totál income for beginning salaries and for each additional year up to ten years.	B1. Identify the salary or wage for career chosen. B2. Determine the duration of educational preparation.
1.50	A. Identify and use the following measurement units: 1. Lined measure-the meter 2. Areas measure-the square meter 3. Mass measure-the kilogram 4. Temperature-the degree celsius 5. Volume measure-a. liquid-the litro b. solid-the cubic metro	A1. Given the proper tools: a. measure the following quantities: 1. length, area, and volume 2. mass, weight 3. temperature b. using the metric stick, measure the length and width of the classroom and record the distance in meters c. from the above measurement, calculate the area of the floor space d. read and record the temperature of Celsius thermometer.

1.7

UNIT II

2.00 PRE-CONSTRUCTION 15 Days

OBJECTIVE: To provide the student with selected practices in pre-construction.

UNIT OUTLINES AND OBJECTIVES

2.10 Beginning the Project

2.11 Selecting the site

2.12 Buying real estate

2.13 Surveying and mapping

2.14 Soil testing

OBJECTIVES: At the end of this sub-unit, the student will be able to:

1. Describe the proper steps for selecting the proper site for construction.
2. Describe the proper steps for buying real estate.
3. Supply rules for surveying and mapping.
4. Demonstrate soil testing.

2.20 Designing and Engineering the Project

2.21 Identifying design problems

2.22 Analyzing the design

2.23 Designing and engineering cycle

2.24 Energy usage, conservation and ramifications related to construction

OBJECTIVES: At the end of this sub-unit, the student will be

able to:

1. Identify design problems.
2. Distinguish between good and bad design.
3. State the steps the designing and engineering cycle.

2.30 Selecting the Builder

2.31 Contracting

2.32 Estimating and bidding

2.33 Scheduling

OBJECTIVES: At the end of this sub-unit, the student will be able to:

1. Identify the proper steps which are necessary in selecting a contractor.
2. Calculate the difference in cost between galvanized and copper pipe used in a plumbing contract.
3. Using the Bar-Chart Procedure and the Critical Path Method explain why work schedules are necessary and how they are developed.

TEXT: Landers, Jack M., CONSTRUCTION, Goodheart and Wilcox Publishing Company, Inc., Chicago, Illinois, 1976.

Landers, Jack M., CONSTRUCTION LABORATORY MANUAL, Goodheart and Wilcox Publishing Company, Inc., Chicago, Illinois, 1976.

REFERENCES: THE WORLD OF CONSTRUCTION, Teachers Guide, IACP, McKnight and McKnight Publishing Co., Bloomington, Illinois, 1970.

Lux, Donald G., INTRODUCTION TO CONSTRUCTION CAREERS.

UNIT NO. II	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
2.00	PRE-CONSTRUCTION THE STUDENT WILL BE ABLE TO:	
2.10	A. Recognize the importance of site selection, recommend a certain site resulting from a feasibility study, given the criteria by which something is judged, select a site, and recognize the two ways of acquiring property.	A1. Find the available sites, decide the feasibility of each site, and select a site for the project given: 1. a picture of possible construction sites, 2. a selected project to build, 3. a table of site feasibility factors.
	B. Given situations related to buying real estate: a. Explain each of the following terms by using examples: 1. boundaries, 2. improvements, 3. natural features, 4. easements, and 5. encroachments; b. Name the kinds of information recorded on a deed for a building.	B1. Using a legal description of a lot, use a direction circle and rule to layout a scaled-down model lot.
	C. a. State why a surveyor begins his measuring from a monument or bench mark, b. List the natural features that may have existed near your school before the land was settled or developed. c. Name what improvements would be shown on a topographic map.	C1. Using a site box, a level bar, stadia rod, and grid chart: a. draw contour lines between like elevation points, b. record elevation data on a grid chart, c. measure elevations with level and stradia rod.

UNIT NO. II	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	D. Describe how soil may affect the following: a. water supply b. building foundations c. basements d. roadways e. drainage f. plant growth	D1. Using measuring devices, containers, and soil samples: a. analyze two soil samples, clay and sand, b. test two soil samples for water absorbtion, c. analyze the soil strength of clay and sand.
2.20	A. Given situations related to identifying design problems, describe the general needs that these structures fill: a. warehouse b. garage c. school d. hospital e. factory f. department store	A1. Given the problem of designing a community park, point out the major needs that the park should meet, list several kinds of data and descide the effect it has on the design problem.
	B. Name what special structural problem should be considered, what functional problems need study before equipment is installed, what site problems need study before equipment is installed.	B1. Given the span dimensions of a bascule bridge and the location of the bridge's pivot point: a. figure the weight needed to counter-balance a load on the bridge, b. test the figures by constructing and counterbalancing a sample bascule bridge.
	C. Given a design situation, a new set of design requirements and an unsatisfactory community park site design: a. redesign the park site in light of the situation and design requirements, b. given a series of drawings and a stapler, assemble the sheets into a set of drawings.	C1. Given a new set of requirements, redesign a new park site.

2.4

UNIT NO. II	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	D. Identify energy sources, usage, conservation methods, and ramifications related to construction methods.	D1. Compare energy uses within construction. D2. Discuss ways for collection and use of energy.
2.30	A. a. Identify reasons why most homeowners hire a general contractor for a construction project. b. Name reasons why general contractors hire subcontractors. c. Describe what kinds of payments are called for in different types of contracts.	A1. a. Groups of students will plan ways to convince a buyer (the teacher) that you should be awarded the contract. b. Study the advantages for each kind of contract: fixed price, cost-plus-fixed fee, cost-plus-percentage of cost, and incentive contracts. c. Following the five minute arguments and reasons supporting their contract the buyer (the teacher) will award the contract based upon the most convincing report.
	B. Give contracting procedures, bids and a contract form: a. select a builder, b. complete the contract form, c. answer questions related to bid selection and contract accuracy.	B1. Work individually to select a contractor from the three choices provided on three contract forms and will then complete their choice of proper contract forms.
	C. Given situations related to estimating bidding: a. suggest the source from which a contractor may get his supplies, labor costs, equipment costs and overhead costs,	C1. Given a plumbing plan, plumbing costs, and a choice of installing either a galvanized iron or copper tubing plumbing system, the student will estimate which system will give them the most profit.

UNIT NO. II	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	b. give reasons that might cause a contractor to raise or lower the profit that is included in his bid.	
	D. Suggest what might happen if a contractor made these errors in scheduling: a. the inside walls were plastered and painted before the electrician arrived to install wiring, b. the kitchen walls and floors were finished before the plumber did his work, c. a truck with ready-mixed concrete arrived, but the forms to hold the concrete were not built.	D1. Given the problem of scheduling a side walk repair and the time required to do each task, will complete the scheduling of a project using the Bar Chart Procedure.

TRANSPARENCIES

11.1	Reading a rule of scale
11.2	Direction Circle
11.3	Property Description
13.1	Topographic Characteristics
13.2	Locating Elevations
13.3	Contour Lines
14.1	What is a Profile?
14.2	Topographic Map, Contours, and Profiles
16.0	Soil Testing
22.0	Grid Sheet
23.0	Designing a Parking Area
41.0	Kinds of Construction Contracts
42.0	Contracting Procedures
43.0	Estimating Plumbing Costs

Selected by number from the WORLD OF CONSTRUCTION TRANSPARENCY SET, McKnight and McKnight Publishing Co., Bloomington, Illinois.

UNIT III

3.00 CONSTRUCTION 60 Days

OBJECTIVE: To provide the student with an understanding of construction activity and utilization of tools, materials, and safety practices.

UNIT OUTLINES AND OBJECTIVES

3.10 Getting Ready to Build

3.11 Clearing the site

3.12 Locating the structure

3.13 Earth moving

3.14 Stabilizing earth and structures

OBJECTIVE: At the end of this sub-unit, the student will be able to:

1. List the name or location of one structure or building that is in the process of being demolished; identify places where unwanted materials from demolished structures are disposed of, and find the name of two companies involved in practices of "clearing the site."
2. Describe what would happen if a new home was incorrectly located and built on someone else's property; and list three kinds of construction workers that would use surveying equipment to locate structures on a site.
3. Identify a location where earth moving is needed and give reasons why earth moving contractors like to have their equipment in use many hours a day.

4. Excavate a model basement located next to a model building and learn how to stabilize the earth to prevent a cave-in.
5. Better understand the importance of roughing-in utilities, expecially the services of electric power, gas, water, communication, and sewage.

3.20 Classifying Structures

3.21 Setting foundations

3.22 Building forms

3.23 Setting reinforcements

3.24 Mixing concrete

3.25 Placing and finishing concrete

3.26 Completing foundations

3.27 Building super structures

3.28 Building mass and masonary super structures

3.29 Building wood frames

3.210 Installing utilities

3.211 Enclosing framed super structures

3.212 Finishing the project

OBJECTIVES: At the end of this sub-unit, the student will be able to:

1. Classify different types of footings used in construction.
2. Construct wooden forms for the placing of concrete.
3. Relate the differences in deformed reinforcing rod and place such reinforcing rod into a finished form in preparation for pouring mixed concrete.

4. a. Figure what length of sidewalk can be made from one cubic yard of concrete (3' x 3' x 3') if the sidewalk is to be 4" thick and 3' wide.

   b. Give several reasons why sidewalks or dirveways of concrete may have small holes in their surface.

5. Identify reasons for using concrete; discuss the purpose of a slump test; and identify job opportunities related to concrete work.

6. Describe what happens when concrete cures and will list several reasons why some hardened concrete surfaces must receive final surface finish.

7. Given information related to building super structures, classify super structures as 1. mass, 2. loadbearing, or 3. framed.

8. a. Give reasons why a highway or airport runway may be considered a mass super structure and why they may be considered as substructures.

   b. Cite examples of how brick and stone are used in building construction other than being used in load bearing wall

9. a. Give reasons why wood framing is used for structures such as homes.

   b. Compare the advantages and disadvantages in building woodframe structures.

   c. Construct bridging and install the subfloor.

   d. Layout the wall plates and studs, cut them to length, and assemble the wall sections.

e. Construct and install window frames, headers and double plates.

f. Layout, construct, and erect roof trusses.

g. Given the completed frame structure, inspect the structure and evaluate the findings.

10. a. Name what utilities service structures in their community.

b. Describe problems if all utilities were shut-off.

c. Identify utility construction currently being used in the community.

11. a. Install wall sheating.

b. Install the soffit and fascia.

c. Install the proper roof sheating, drip and rake edges.

d. Install shingles as well as assemble a window frame.

e. Apply siding.

f. Install a window unit.

g. Install insulating materials.

h. Cut and apply drywall material.

i. Tape and cement the interior surface joints.

j. Apply ceiling materials.

k. Install flooring material.

12. a. List several tasks that finish a construction project.

b. Give examples of finishing practices that must be completed before a structure can be used.

UNIT NO. III	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
3.00	CONSTRUCTION THE STUDENT WILL BE ABLE TO:	
3.10	A. Do the following: a. name the kinds of zones in a city, b. describe the restrictions that apply in some areas of the city, c. identify who must be protected at a construction site, d. identify some dangers that workers must be protected from, 3. describe some ways in which the contractor provides for safety.	A1. Given a site box and a construction site plan: a. locate buildings, water mains, telephone lines, roads and property lines; b. locate temporary facilities where they will be most efficient.
	B. Identify obstacles, select practices, and equipment for clearing the site.	B1. Given an illustration of an apartment building site and an efficiency chart which specifies costs, determine the most efficient techniques for disposing of site obstacles and determine the cost of clearing. B2. Identify and locate temporary facilities.
	C. Given a demonstration and discussion on how to locate a structure on a building site: a. locate batter board locations, b. construct batter boards.	C1. Given the equipment and supplies, a site box and some string: a. construct right-angle batter boards to be used to locate a structure on a simulated building site, b. locate the outside walls of a building by running lines to points on the batter board, c. locate the four corners of a building.

UNIT NO. III	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	D. Calculate how many truckloads of soil are needed to fill an excavation.	D1. Given an earth moving problem of filling a 100 cubic yard hole with compacted soil and a truck that can carry 10 cubic yards of soil, calculate how many truckloads of soil are needed to fill the hole with compacted soil.
	E. Demonstrate what can be done to prevent the sides of an excavation from caving in on workers, and what must be done to support an existing structure if earth is removed very close to its foundation.	E1. Given a site box filled with two inches of moist sand, two concrete blocks, and wood underpinnings: a. underpin a simulated structure during excavation of an adjacent area, b. excavate the area between the two model buildings and stabalize the earth.
	F. a. Identify the utilities needed in construction. b. Identify the sources for the utilities needed. c. Describe how utilities attribute to our standard of living. d. Estimate the cost of installing the utilities.	F1. a. Name the utilities found in construction. b. Visit a construction site and list the utility serviced roughed-in. c. Visit local utility company. d. Obtain data from local architects on the costs of roughing-in utilities.
3.20	A. a. State the reasons for using a foundation. b. Identify which foundation element is used to distribute the weight of the structure over the soil.	A1. Given the prescribed materials the student will test moist sand without footing and with using spread footings, identify the footings as: a. floating footing, b. spread footing, c. pile cap foundation.

3.7

UNIT NO. III	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	B. Identify at least two concrete surfaces that were shaped against forms and tell if these were foundation forms or forms for super structures.	A1. Using the equipment, supplies, and drawings for a footing form, the students will measure, mark, saw, and assemble the pieces to construct a footing form.
	C. a. Give reasons why reinforcing steel rods are deformed and consider why smooth surfaced reinforcing steel would not work as well. b. Determine whether or not reinforcing steel in concrete will allow a solid concrete mass to "bend".	C1. Given a footing and column requirement, measure, mark, cut, bend, seat, and tie reinforcing steel in the form.
	D. a. List how many "ready-mix" concrete mixing plants are located in the surrounding community. b. State the proportions for a concrete mix. c. Tell what a slump test is and why it is important. d. Name the steps involved in mixing and placing concrete into a form.	D1. Participate in the teacher demonstrations of concrete mixing and will take part in the classroom discussion.
	E. a. Identify at least one trowell finish, one float finish, and one broom finish around the home or school. b. Describe how weather affects concrete finishing.	E1. Given the necessary equipment and supplies and footing form, proportion, mix, text, place, rod, scrub, and finish concrete to make a concrete footing.

UNIT NO.	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	F. a. State how long it takes for concrete to set and cure. b. State why concrete should be kept moist while curing. c. Relate personal observations of concrete work on a construction site.	F1. a. Take the footing form apart with a wrecking bar. b. Remove all nails from the form materials. c. Scrape the forms to remove any extra concrete and store the materials.
	G. Match each super structure with a suitable material.	G1. Choose a suitable construction material using Activity 43 in World of Construction, laboratory manual for each super structure.
	H. a. Mix mortar to the proper consistency for placing brick or concrete block. b. Lay brick or concrete block in a neat, orderly fashion. c. Tool the joints when the mortar has set thumbnail hard.	H1. a. Measure and mark the footings for the mortar bed. b. Mix the mortar. c. Tool the joints when the mortar has set thumbnail hard.
	I. a. Measure, mark and saw materials to length, and assemble the rough floor framing of a model structure. b. Construct bridging in a floor structure and install the subfloor. c. Layout the wall plates and studs, cut them to length, and assemble wall sections. d. Construct and install a window frame and a double header. e. Layout, construct, and erect roof trusses. f. Given a completed wood frame structure, inspect the workmanship for accuracy and pass or reject the structure.	I1. a. Organize materials and begin construction of a floor section. b. Measure, cut, and install bridging and subfloor. c. Layout, measure, cut and install wall plates and studs forming wall sections. d. Construct and install window frames and double headers. e. Layout, construct and erect roof trusses. f. Given the completed wood frame structure, inspect the workmanship for accuracy and pass or reject the structure.

3.9

UNIT NO.	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	J. a. Given the names of several devices and functions concerning heating, c cooling and ventilating systems, associate each device and function with treating air, circulating air, or controlling some part of the system. b. Cut and ream copper tubing; flux, assemble, and sweat-solder a copper tubing joint, prepare plastic tubing by cutting, clearning and bonding joints; and install these utilities. c. Layout electrical runs, bore holes in framed members, and install electrical boxes.	J1. a. Fabricate and install three ductwork pieces; boot, cap, and duct. b. Cut and ream copper tubing; prepare plastic tubing for installation in wood frame structure. c. Using the proper equipment and supplies, and following safe and proper procedures layout electrical runs, drill holes to receive the electrical wiring, and install the utility system.
	K. a. Measure, saw and nail exterior wall sheating on the model structures. b. Apply the roof sheating, drip edge, and rake edge to the structure. c. Apply the roof shingles and assemble a window unit. d. Apply siding to the outside to the structure. e. Install the soffit, the return facia, and the rake to the structure. f. Install a window frame unit into the structure. g. Insulate the outside walls of the strucutre.	K1. a. Prepare and install the wall sheating to the outside walls of the structure. b. Mark, cut and apply the roof sheating, drip edge, and rake edge to the structure. c. Measure, mark and apply the roof shingles as well as assemble a window frame. d. Apply the siding to the outside walls of the structure. e. Measure, cut and install vertical siding on the gable end of the structure. f. Install a window frame unit into the module, and bend and install flashing over the window frame. g. Insulate sample wall section.

UNIT NO.	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
	h. Apply drywall materials to the inside walls of the structure. i. Tape and cement the joints on the interior walls. j. Apply ceiling materials. k. Install flooring covering.	h. Apply drywall materials. i. Tape and cement drywall joints. j. Using the proper equipment and supplies install furring strips and ceiling tile into the module. k. Install vinayl tile or carpeting on the floor of the structure.
	L. Install baseboard, base shoe, and cove molding on the interior of a structure, and inside window casings.	L. Layout, measure, cut and install baseboard, base shoe, cove molding and window casings, on the interior of a structure.
3.30	A. a. Develop a plot plan site. b. Analyze the site. c. Choose landscape structures and materials. d. Design public and living areas. e. Estimate the cost of landscaping.	A1. a. Study and develop a plot plan. b. Review appropriate brochures, catalogs, and literature regarding landscape structures and materials. c. Select plantings which are hardy for their climate. d. Discuss appropriate public and living areas. e. Study and extimate the cost of trees, shrubs, flowers, ground cover, stone and concrete structures, and prepare soil and properly plant a plant.

3.11

	TRANSPARENCIES	Selected by number from the WORLD OF CONSTRUCTION TRANSPARENCY SET, McKnight and McKnight Publishing Company, Bloomington, Illinois.
57.1	Zoning Map	
57.2	Building Placement	
57.3	Building Permit	
58.1	Site Factors Affecting Work	
58.2	Demolishing	
60.1	Batterboards	
60.2	Locating the Corners	
60.3	Checking for Accuracy	
61.1	Excavation Classifications	
61.2	Excavation Classifications Continued	
61.3	Equipment	
61.4	Equipment	
61.5	Equipment Hand Tools	
61.6	Equipment	
62.1	Earthmoving Techniques	
65.1	Stabilizing Existing Structures	
65.2	Piling	
65.3	Sheating and Copper Damming	
65.4	Bracing and Shearing	
68.1	Classifying Structures	
68.2	Idenfitying Structures	
68.3	Identifying Structures	
94.1	Fabricating Ductwork	
107.0	Built up Roof	
113.1	Glazing with Compound	
113.2	Glazing with Compound	
170.0	Landscape Plan	

BRICKLAYING

INTRODUCTION:

The use of lime mortar in bricklaying is not a new innovation. The early pioneers used lime to build chimneys, and many of those chimneys are now a hundred years old and still are in use. Lime mortar does not weather well, but in protected areas it has the capability of wearing for a long time. I use it in teaching World of Construction because the brick can be cleaned easily even after several weeks and stored for re-use later. Also the lime dries white and when used with dark bricks makes a very eye-appealing contrast.

OBJECTIVES:

As a result of their learning experiences, the students should gain some insight into how brick is lain in courses in a bearing wall and practice doing the job that a professional bricklayer is usually called to perform.

LABORATORY ACTIVITY:

Given the equipment and supplies, mix the mortar, lay out the area for the mortar bed, and lay brick in level courses to build a bearing wall.

EQUIPMENT (group of 5)

1 pointed trowel
1 jointing tool (may be a piece of copper pipe ½ inch I.D.)
4 ft. 2 x 4 for leveling and keeping the wall straight
4 ft. 2 x 6 for the footing
mortar box
pointed shovel
garden hoe
sheet of plastic 3' x 6' or equivalent
1 hammer
1 brush

SUPPLIES (group of 5)

dozen common brick (enough for one class activity)
3 shovelfulls of screened sand
1 shovelfull of lime
water

LABORATORY ACTIVITY:

During this exercise the students will lay brick on their footings (which in case is a four ft. length of 2 x 6).

1. The teacher should give specific instructions for the students to follow in the laboratory activity.

   a. Students should work in groups of five. One student can be appointed by the teacher to act as the foreman of the group. Another can be the equipment manager. It would be his job to secure the necessary tools for his group and return them clean after the activity is over. The other three could be in charge of cleanup so that the mortar box, hoe, shovel, and plastic would be cleaned and put away before dismissal.

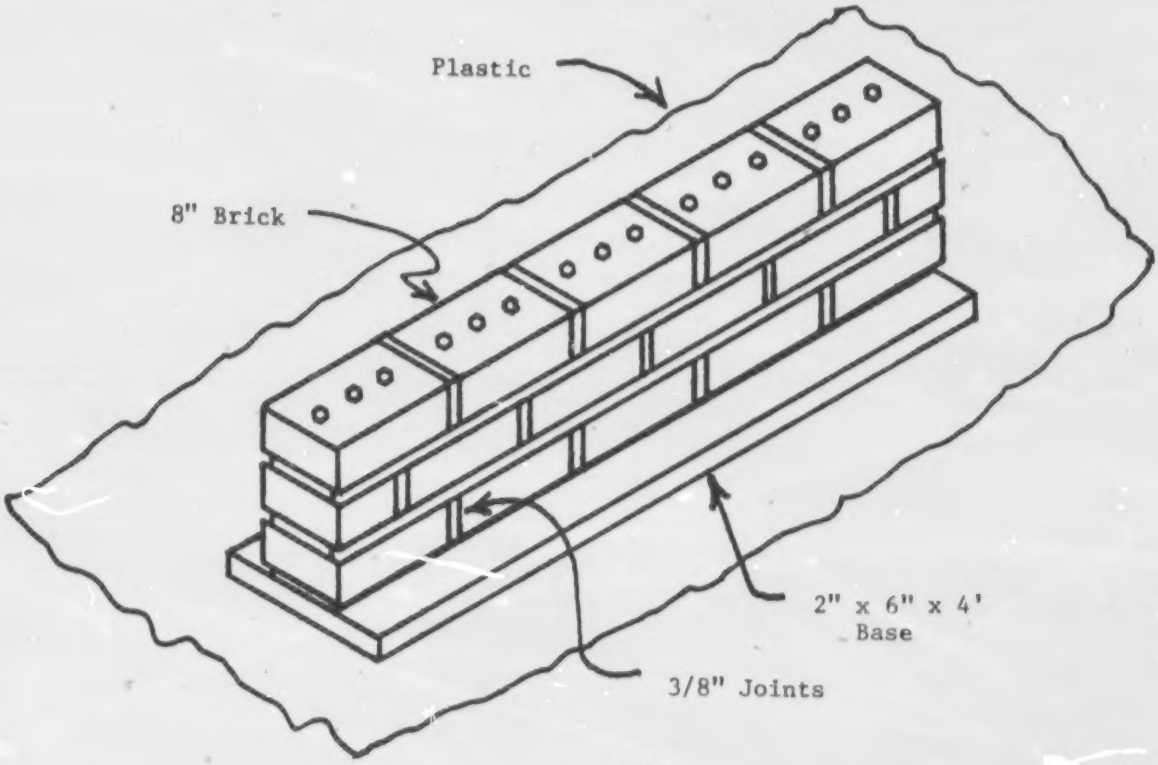
   b. Each group should mix their mortar in their own mortar box. This is necessary so that if one group would add too much water, and the mortar would be too thin and difficult to work with, the whole class would not be penalized. Batch proportions are three level shovelfulls of sand and a heaping shovelfull of lime. Mix the sand and lime together dry and then add water enough to make a thick mortar which will stick to the trowel even if the trowel is inverted. The students may use the mortar directly out of the mortar box, thus eliminating the need for a mortar board.

   c. Place enough mortar on the 2 x 6 footing and spread the base for the brick. Start with a full brick at one end; place mortar on the end of the second brick and slide it into place so that a joint 3/8" thick will be formed between the two brick. Continue in this manner until all six brick have been laid covering the entire length of the footing. Place a 2 x 4 lengthwise on its narrow side on top of the brick and tap down until all brick are level and the thickness of the joint is approximately 3/8". Next place the 2 x 4 on the outside of the wall and tap until all brick are nicely in line. (I do not teach the students how to use the level to keep the wall plumb or chalkline to keep the wall straight. Tomorrow when they take their walls out to lay two more courses of brick, they may work in a slightly different spot and no shop floor is perfectly level.) Laying more than two courses of brick per class period will result in the joints sagging between the courses.

   d. Each group should be able to lay two courses of brick per class period and tool all exposed joints after the mortar has become thumbnail hard. Explain to the class that pointing improves the looks and water seal, and makes the surface smooth.

   e. Allow enough time for cleaning up. The last ten minutes of class should be used to brush off all loose mortar; the footings with the brick walls on them may be slid into a suitable place for storage until the next class period. All tools should be washed thoroughly in water, and all tools and materials returned to their proper places. The tools and mortar boxes should not be washed in the sink as the sand will plug up the trap in the drain. Dispose of properly and flush down with plenty of water.

2. The teacher should observe the students, offer suggestions, and answer questions.



ADDITIONAL INFORMATION:

1. Most of the brick used to build bearing walls are 8" long, 3 3/4" wide, and 2 1/4" thick. The MASON stands in front of the wall he is building to spread MOTAR on the lower layer of brick before placing the next brick.

   There are six positions in which the bricklayer can place this brick in a wall, and each of these positions has a name. The positions of a brick are those the bricklayer would see looking at the front face of the wall.

   Brick is laid in COURSES in a bearing wall. If a brick is laid in a course in the flat position so that the 8" dimension is along the course and the course is 2 1/4" high, the brick is called a STRETCHER The course is called a STRETCHER COURSE.

   If we turn the brick on end so that the 8" dimension is pointing up and down, the brick is called a SOLDIER. If the brick is turned so that the end show, with the 3 3/4" along the course, the brick is

1. Donald G. Lux, Willis E. Ray: The World of Construction, Bloomington, Illinois, McKnight & McKnight Publishing Company, 1970, Page 252.

called a HEADER. If the brick is turned 90° so that the 2 1/4" side lies along the course, it is called a ROW-LOCK. Two other positions in which brick may be placed in a wall as a SHINER or SAILOR are not often used.

Brick walls are generally built or laid-up with stretcher courses. When they are only one brick wide, the walls are 3 3/4" thick. This much of a wall is called a WYTHE. Usually two or three wythes are laid up together to form a bearing wall. However, often only one wythe is used to cover or put a face on a concrete or wood frame wall.

UNIT IV

4.00 POST-CONSTRUCTION 5 Days

OBJECTIVE: To provide the student an understanding of the activity in servicing and transferring the construction project and property.

UNIT OUTLINES AND OBJECTIVES

4.10 Servicing the Property

OBJECTIVE: The student will be able to identify needed alterations and repairs necessary to place the structure into operating condition.

4.20 Transferring the Project

OBJECTIVE: The student will be able to name three things necessary to transfer the property from the builder back to the legal owner.

TEXT: Landers, Jack M., CONSTRUCTION, Goodheart and Wilcox Publishing Company, Inc., Chicago, Illinois, 1976.

Landers, Jack M., CONSTRUCTION LABORATORY MANUAL, Goodheart and Wilcox Publishing Company, Inc., Chicago, Illinois, 1976.

REFERENCES: THE WORLD OF CONSTRUCTION, Teachers Guide, IACP, McKnight and McKnight Publishing Co., Bloomington, Illinois, 1970.

Lux, Donald G., INTRODUCTION TO CONSTRUCTION CAREERS, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1975.

UNIT NO. IV	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
4.00	POST-CONSTRUCTION THE STUDENT WILL BE ABLE TO:	
4.10	A. Cite several changes necessary to the operation of the structure, which became necessary because of changes which became effective since the design and contract to build were started.	A1. Discuss operating the property which would include maintenance people such as custodian, repairmen, electricican, etc. A2. Discuss who does the servicing and who has the responsibility of housekeeping, alterations and installation.
4.20	A. Tell when a project is closed and what this means to the contractor or owner. B. Complete a contractor's warranty form and a contractor's release form. C. Study a "release of lien" form.	A1. Record mistakes found in the inpection of the structures built by the class. B1. Complete a contractor's warranty form and a contractor's release form. C1. Study a "release of lien" form.

4.2

TRANSPARENCIES

155.2	Residential Construction Loan Repayment Schedule
155.3	Real Estate Mortgage Information

Selected by number from the WORLD OF CONSTRUCTION TRANSPARENCY SET, McKnight and McKnight Publishing Co., Bloomington, Illinois.

RESOURCES

APPENDIX A

CONSTRUCTION TECHNOLOGY

BIBLIOGRAPHY

Exploring the Construction Industry, Teacher's Edition, student textbook, and and student activity booklet, McKnight and McKnight Publishing Co., Bloomington, Illinois.

Landers, Jack M., Construction Laboratory Manual, Goodheart and Wilcox Publishing Co., Inc., Bloomington, Illinois.

Landers, Jack M., Construction Materials, Methods, and Careers, Goodheart and Wilcox Publishing Co., Inc., Chicago, Illinois, 1976

Lux, Donald G., Introduction to Construction Careers, McKnight and McKnight Publishing Co., Bloomington, Illinois, 1975.

The World of Construction, Teacher's Guide, student textbook and student laboratory manual, McKnight and McKnight Publishing Co., Bloomington Illinois.

APPENDIX B

CONSTRUCTION TECHNOLOGY

VISUAL AIDS SOURCES

FILMSTRIPS

1. Building an Award Winning Highway with Asphalt

   The Asphalt Institute
   Asphalt Institute Building
   College Park, MD 20740

2. Foam Construction

   Society of Plastic Engineers
   Philadelphia Section
   Mr. Frank C. Starr, Jr.
   Education Chairman
   2010 Harvey Road
   Wilmington, DL 19810

3. Milling Practice Parts 1, 2, 3, 4, 5 & 6

   Kearney & Trecker Corporation
   Advertising Department
   11000 Theodore Trecker Way
   Milwaukee, WI 53214

4. Versatile Timber Construction

   American Institute of Timer Construction
   333 West Hampden Ave.
   Englewood, CO 80110

5. What Consumers Should Know About Truth in Lending

   Federal Reserve Bank of Minneapolis
   Public Information Department
   250 Marquette Ave.
   Minneapolis, MN 55480

16 MM FILM

1. Designing with Timber Foundation Piles — 20 Min.

   American Wood Preservers Institute
   ATTN: Visual Aids
   1651 Old Meadow Road
   McLean, VA 22101

2. Installing Armored Cable — 27 Min.

National Electrical Manufacturers Association
Charard Motion Pictures Inc.
2110 East 24th Street
Brooklyn, NY 11229

3. Let's Go Home — 30 Min.

Georgia Pacific Corporation
Educational Film Library
900 S.W. Fifth Ave.
Portland, Oregon 97204

4. Movable Bridges — 29 Min.

United States Steel Corporation
Chicago Film Center
208 South LaSalle Street
Chicago, IL 60690

5. Shape of the Future with Gypsum Wallboard — 23 Min.

Gypsum Association
Film Library
1603 Irvington Ave.
Evanston, IL 60201

6. USS Homaday Building Components — 20 Min.

United States Steel Corporation

7. A Window Is — 18½ Min.

Association-Sterling Film
6420 West Lake Street
Minneapolis, MN 55426

8. Future in Concrete — 14 Min.

Ideal Cement Company
4431 West North Ave
Milwaukee, Wisconsin 53208

The Following are rental films from:

North Dakota State Film Library
Division of Independent Study
State University Station
Fargo, ND 58103

1. An Architect at Work

2. Building a House

3. Homes Around the World

4. Making Bricks for Houses

5. New House--Where It Comes From

6. Pioneer Home

7. Pioneer Living: The Home

8. Repainting a Frame Building

9. Shelter

The following are rental films from:

Michigan State University
Instructional Media Center
East Lansing, MI 48824

1.	Concrete Example (Portland Cement)	16 Min.	$2.50
2.	Developing the Space Near Buildings		2.50
3.	Home Landscaping		2.50
4.	Intruder		3.00
5.	New Guidelines for the Well Landscaped Home		2.50
6.	Problems of Housing (The Individual Home)		3.25
7.	No Longer Worried (Fire Insurance)		2.50

OTHER

BOOKS:

Maintaining the Lighting and Wiring System	4.50

AAVIM
120 Engineering Center
Athens, GA 30602

Architecture--Residential Drawing and Design	8.94
Blue Print Reading	5.97

House Wiring Simplified $4.47

Goodheart-Wilcox Company, Inc.
123 W. Taft Drive
South Holland, IL 60473

APPENDIX C

CONSTRUCTION TECHNOLOGY

MATERIALS AND EQUIPMENT

TEACHING AIDS AND SPECIAL EQUIPMENT

All equipment, tools and material listed are for a class of 20 students maximum. If classes are large or smaller, instructors are to make necessary adjustments to the items listed.

TRANSPARENCIES

It is imperative that all schools or instructor use the transparencies as recommended by IACP World of Construction.

16 MM FILMS

Suitable films on construction industry, building dams, bridge building, road building and building skyscrapers.

FILM STRIPS

It is imperative that all schools or instructors use the film strips as recommended by IACP World of Construction.

TESTS

One set as recommended by IACP World of Construction.

AUDIO VISUAL EQUIPMENT

1_Overhead projector/screen

1_Film strip projector/screen

1_16 MM projector/screen

1_Tape recorder

SPECIAL EQUIPMENT

4_Bow drills w/hard block

1_Class organization chart (included in teacher manual)

4 per class_Site boxes

4 per class_Level bars

4 per class_Stadia rods

4 per class_Level bar pin

4 per class_Big Builder Game

4 per class_Working drawings (American Homes Inc.)

1 set per class-Employment Role Playing Cards

4 per class-Obstacles for clearing (trees, shrubs, water, etc.)

DEMONSTRATION ITEMS

1-Piled foundation (3 legged support)

6-Copies of working agreement regulations between a construction union and a contractor

1-Transite (or several fire bricks)

1-2 cast iron soil pipe

1-1 clay soil pipe

1-2 plastic pipe

1-Local building inspection card

1-10" X 16½" single strength glass

12-Glaziers points

1-½#glazing compound

2-Candles

1-Heat lamps with clamp

2-Cardboard boxes 1 cu. ft.

3-Telephone directories

5-Builders supply catalogs

2-Sears catalogs

2-Wards Catalogs

TOOLS AND EQUIPMENT

MEASURING OR LAYOUT TOOLS

1-Clock or watch with second hand

20-12" rules

20-Architects scales

4-Yardsticks

6-12' x ½" Steel tapes

4-Compass with pencil

4-Wing dividers

6-teaspoons

4-1 cup plastic measure

4-1 qt. plastic measure

SHEET METAL TOOLS AND EQUIPMENT

4-Hand seams or pan brake

4-Tinner's setting hammer (or wooden mallet)

4-Center punches

4-1 slip roll (or 5 round stakes) (or 1 ft. of 2" diameter pipe)

4-Cold chisels

4-5/16" hand groovers

4-Aviation snips (or equivalent)

4-Scratch awl (or scribers)

4-Bar fold (optional)

PLUMBING TOOLS AND EQUIPMENT

4-Pipe vise (or bench vise)

4-Pipe cutters

4-Pipe reamers

4-½" die and stock

4-5" Pipe wrenches

4-Tube cutter w/reamer

4-Handsaws

4-Propane torch (small tip)

4-Strickes for torch

MASONRY TOOLS AND EQUIPMENT

4-Mason's line

4-Plumb bob and line

4-24" spirit level

8-Brick or mason's trowel 10½" London pattern

4-Steel finishing trowel

4-Hand garden trowel

4-Brick chisel

4-Brick hammer

4-3/8" Jointing tool

1-Mortar box

2-Mixing hoe

2-Shovels (round nose)

4-Motar board 24" x 24"

4-Hawks (plasterer's) 12" x 12"

CARPENTRY TOOLS AND EQUIPMENT

1-¼" Hand drill

1-½" Portable electric drill

4-Crosscut saw

2-Ripsaws

2-Compass saw (or saber saw)

2-Coping saws

1-Miter box with back saw

4-Braces

4-Block planes

4-Nail sets

4-Framing square

4-Combination squares

4-Sliding T-level

4-Chalkline

9-Claw hammers (13 or 16 oz.)

4-Wooden mallets

4-12" ripping bar (or nail claw)

2 sets-Auger bits (#4 to #16)

2 sets-Twist drills (1/8" to 1/2")

2 sets-Speed bits (1/4" to 1")

ELECTRIC TOOLS AND EQUIPMENT

1-½" Conduit bender

4-Cable ripper (Romex)

4-Electrician knife (or wire stripper)

4-American B & S wire gauge

1-25' extension card

GENERAL TOOLS AND EQUIPMENT

4-4" screwdrivers (standard)

2-Adjustable wrenches (or 9/16" socket wrench)

4-Needle nose pliers

4-6" slip joint pliers

4-Side cutter pliers

4-Half round file and handle

4-Round file 10" and handle

4-Utility knives

4-Staple gund for 9/16" staples

4-Desk stapler

1-Mastic applicator

4-Putty knives

4-Tape knives

4-Paint scrapers

4-C-clamps

20-3" scissors

4-Dusting brushes

20-Nail aprons

20-Safety glasses

1-broom

1-Caulking gun and tube

1 set-Saw horses (or equivalent)

1-Rake

20-Artist's paint brushes

4-1½" paint brushes

4-3" paint brushes

4-Paint paddles

4-Paint rollers and pan

4-2 gallon bucket

4-Workbenches and vises

4-barrels (or garbage cans)

1-Step ladder 5' or 6'

LIST OF EXPENDABLE MATERIALS

Based on 20 students per class. All materials listed are for one class-multiply materials by number of class held.

PLUMBING SUPPLIES

4	½" x 36" galvanized pipe
4	½" galvanized drapeared elbow
4	½" 90° galvanized elbow
8	1/8" galvanized pipe clamp
4	½" x 14" type "L" hard copper tubing
4	½" FIP copper drapeared elbow
1 can	Pipe dope w/brush (½ pint)
1 qt.	Cutting oil
1 lb.	50-50 solder
1 can	Soldering flux w/brush
5 pads	Steel wood
5	1" ring of 2" diameter pipe

Miscellaneous

5	Sponges (2" x 6" x 10") or (2" x 1" x 6")
1 qt.	Liquid detergent
30	Rags
1 qt.	30 w motor oil
1 roll	Paper towel
10	½ gal. milk cartons (waxed or plastic coated)
4	3" plastic funnels
4	Small cardboard boxes
1 roll	Aluminum foil
2	Paper towel rolls
6	Small rocks, stones
10	1 lb. coffee cans
4	60 watt light bulbs

8 gals.	Clay (earth
1 spool	Thread

WOOD AND COMPOSITION MATERIALS

4 pieces	2" x 6" x 10' Common lumber
38 pieces	2" x 4" x 8' Common lumber
4 pieces	1" x 6" x 10' Common lumber
12 pieces	1" x 4" x 8' Common lumber
8 pieces	1" x 3" x 8' Common lumber
4 pieces	1" x 2" x 8" Common lumber
2 pieces	1" x 6" x 8' V joint (T '6) vertical siding, min. 4'
4 pieces	½" x 2¼" x 8' casing
4 pieces	½" x 2¼" x 6' baseboard
4 pieces	½" x 3/4" x 6' base shoe
4 pieces	.3/4" x 3/4" x 6' cove molding
12 pieces	½" x 12" x 8' siding
1 sheet	½" x 4' x 8' exterior plywood
1 sheet	3/8" or ½" x 4' x 8' plywood paneling
4 sheets	½" x 4' x 8' CDX plywood sheathing
4 sheets	½" x 4' x 8' Composition sheathing (or equivalent)
1 sheet	3/4" x 4' x 4' insulation board (or equivalent
4 sheets	1/8" x 4' x 8' fiberboard (or hardboard equivalent)
	Wood scraps

PAPER AND OFFICE SUPPLIES

80 sheets	8½" x 11" White paper
1 ream	8½" x 11" Tracing paper
20 sheets	12" x 18" Tracing paper
80 sheets	12" x 18" Grid paper, ½" x ½" grid
20 sheets	12" x 18" Grid paper, 1/8" x 1/8" grid
60 sheets	8½" x 11" grid paper, ¼" x ¼" grid
4 sheets	12" x 18" Poster paper
4	9" x 117/8" Manila file folders
40	3" x 5" Index cards blank
10	Felt markers of 5 colors
1	Transparency marker (grease pen)
20	4-H pencils
20	2-H pencils
20	Erasers
4	Crayon, black lecmber
1 box	Thumb tacks
1 box	Paper clips
5 rolls	3/4" Masking tape
1	Ball of string (100')

FINISHING MATERIALS

1 qt.	Latex paint (color desired) exterior
1 qt.	Latex paint (color desired) interior
1 qt.	Clear shellac
1 qt.	Mineral spirits
1 qt.	Alcohol
1 can	Putty
1 tube	Caulking compound

LANDSCAPING MATERIALS

1	Small tree or shrub
10 lbs.	Peat moss
5 lbs.	"10-6-4" Fertilizer
2	1" x 2" x 6' stakes
6'	Stove pipe wire

METALS

4 pieces	50" galvanized drip edge
4 pieces	24" galvanized rake edge
4 sheets	28 ga. x 5" x $27\frac{3}{4}$" galvanized (or equivalent) sheet metal
4 sheets	28 ga. x 4" x 13½" galvanized (or equivalent) sheet metal
4 sheets	28 ga. x 5" x 13" galvanized (or equivalent) sheet metal
8 pieces	3" x 14" sheet metal strips (any gauge)
4 pieces	2" x 16" sheet metal strips (any gauge)
2 pieces	4" x 10" sheet metal (any gauge)
23'	3/8" steel re-rod (or equivalent)
8 pieces	10" Coat hanger wire (or equivalent)
30'	16 gauge black iron wire
1	Shim (scrap)

CONCRETE AND MASONRY MATERIALS

35	2¼" x $3\frac{3}{4}$" x 8" Common face bricks
25	8" x 8" x 16" Concrete block
10	8" x 8" x 8" Concrete block
1	Bag lime
1	Bag cement

4	Bags 100# sand
4	Bags 100# coarce aggregate
ELECTRICAL	
5	4" electrical octagonal outlet boxes
5	22 3/8" adjustable bar hangers
5	Duplex outlet boxes
5	Switch box w/loom clamp and bracket
10'	½" x 10" thin wall conduit (EMT) for demonstration only
1	½" EMT box connector (for demonstration only)
1	½" EMT hanger (for demonstration only)
10'	#12 T.W. wire (white) (for demonstration only)
10'	#12 T.W. wire (black) (for demonstration only)
10'	#12 T.W. wire (green) (for demonstration only)
10'	#12/2 w/ground flex armored cable (BX) (for demonstration only)
1	Armored cable (BX) box connector for 3/8" cable (for demonstration only)
1	Insulating bushing for 3/8" BX cable (for demonstration only)
5	3/8" armored cable staples
15	#12/2 w/ground non-metallic sheathed cable (Romex)
5	2" Romex staples
5	Parallel ground duplex receptable w/cover plate
5	Single pole toggle switch 2/cover plate
5	Keyless procelain lamp receptacles
5	Wire nuts for #12 wire
5	Mole plug 3-prong
10	Metal ground clips

ROOF, WALL, FLOOR, CEILING MATERIALS

1 bundle	Master lock shingles-asphalt
4	52¼" starter strip
1 roll	15# felt paper
15'	2" x 14½" roll blanket insulation (or friction fit)
4 sheets	3/8" x 4' x 4" gypsum board
1 package	Joint treatment cement
1 roll	Joint tape
40#	Mill mixed gypsum plastic (optional)
20	12" x 12" acoustical tile
20 sq. ft.	Vinyl floor tile
1 qt.	Floor tile mastic (for demonstration only)

FASTENERS

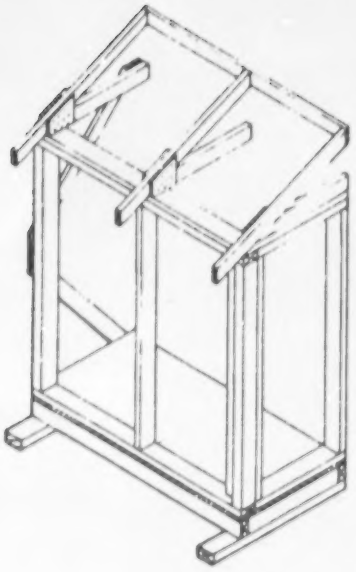
30	#8 x ½" sheet metal screws
10	#8 x 3/4" flathead screws
2½#	6d common nails
1#	8d common nails
1#	16d common nails
1#	6d box nails
1#	8d box nails
2#	½" #18 roofing nails
2#	4d finishing nails
2#	8d finishing nails
1 pt.	Rubber cement
5 pts.	White glue
1 box	¼" staples
1 box	9/16" staples for staple gun
8	½" x 6" square head bolts 2/nuts and washers

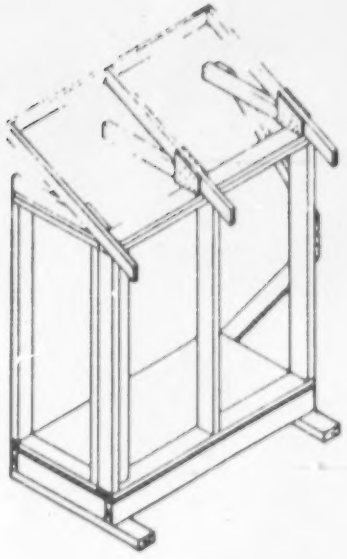
NOTE: The following illustrations were developed by authors for McKnight Publishing Co. They are included in this guide for your viewing.

STRUCTURE # 1

1 MODULE (A OR B)
4 STUDENTS PER MODULE

SIZE: 2' X 4'





Materials have been rounded to standard sizes. A detailed analysis is included in the text.

BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
1	1/4" x 4' x 8' plywood	____	____	____
1/2	1/2" x 4' x 8' plywood	____	____	____
1	3/4" x 1 3/4" x 66" pine	____	____	____
1	1" x 4" x 4'	____	____	____
1	1" x 4" x 10'	____	____	____
1	1" x 6" x 8'	____	____	____
1	2" x 4" x 6'	____	____	____
7	2" x 4" x 8'	____	____	____
86"	10' galvanized tin drip edge	____	____	____
15lbs	36" wide building felt	____	____	____
6	12" x 36" asphalt shingles	____	____	____
1	9" x 52 1/4" asphalt starter strip	____	____	____

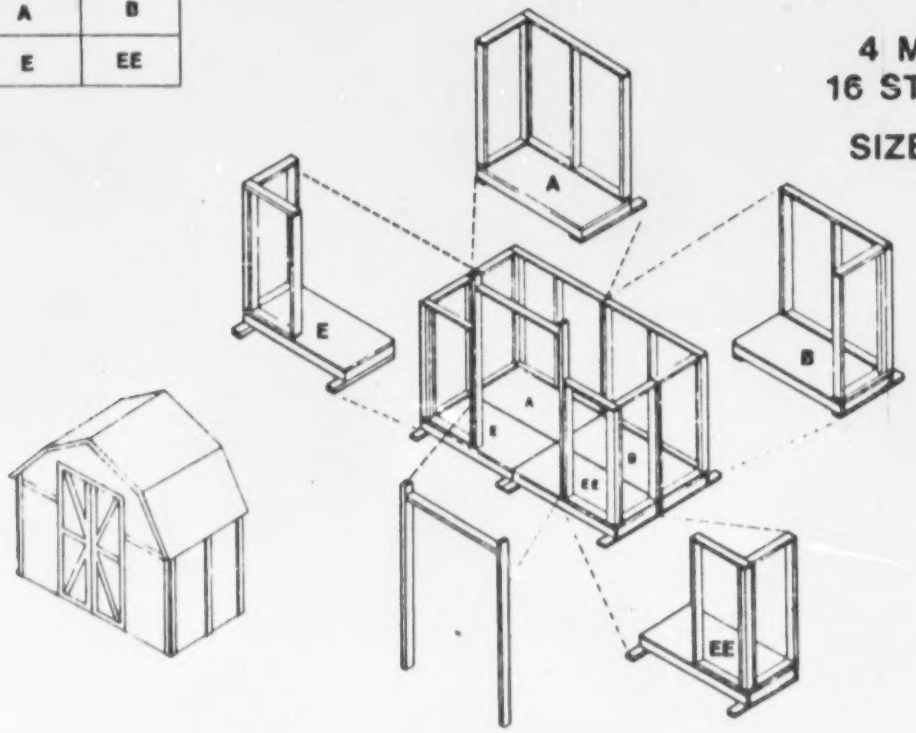
BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
	6d nails	____	____	____
	8d nails	____	____	____
	6d galvanized nails	____	____	____
	8d galvanized nails	____	____	____
1/2 lb	1/2" galvanized roofing nails	____	____	____

WINDOW (Optional)
Can be included in all six structures.

BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
2	3/4" x 1" x 4' pine	____	____	____
2	3/4" x 2 1/2" x 4' pine	____	____	____
1	3/4" x 4 1/2" x 6' pine	____	____	____
1	3/4" x 5 1/2" x 23" pine	____	____	____
1	1 3/8" x 6' pine	____	____	____
1	12" x 16" glass or plexiglass	____	____	____
2	1 1/2" butt hinges	____	____	____
1	hook and eye	____	____	____

STRUCTURE # 2

A	B
E	EE



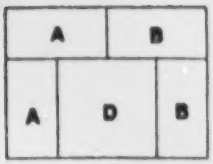
4 MODULES
16 STUDENTS

SIZE: 4' X 8'

BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
2 1/2	1/4" x 4' x 8' plywood	___	___	___
4 3/4	1/2" x 4' x 8' plywood	___	___	___
6	3/4" x 1 1/2" x 8' pine	___	___	___
9	1" x 1 3/4" x 43 3/4"	___	___	___
4	1" x 2 3/4" x 47 1/4"	___	___	___
9	1" x 4" x 4'	___	___	___
13	1" x 4" x 8'	___	___	___
2	1" x 4" x 10'	___	___	___
3	2" x 4" x 4'	___	___	___
8	2" x 4" x 6'	___	___	___
26	2" x 4" x 8'	___	___	___

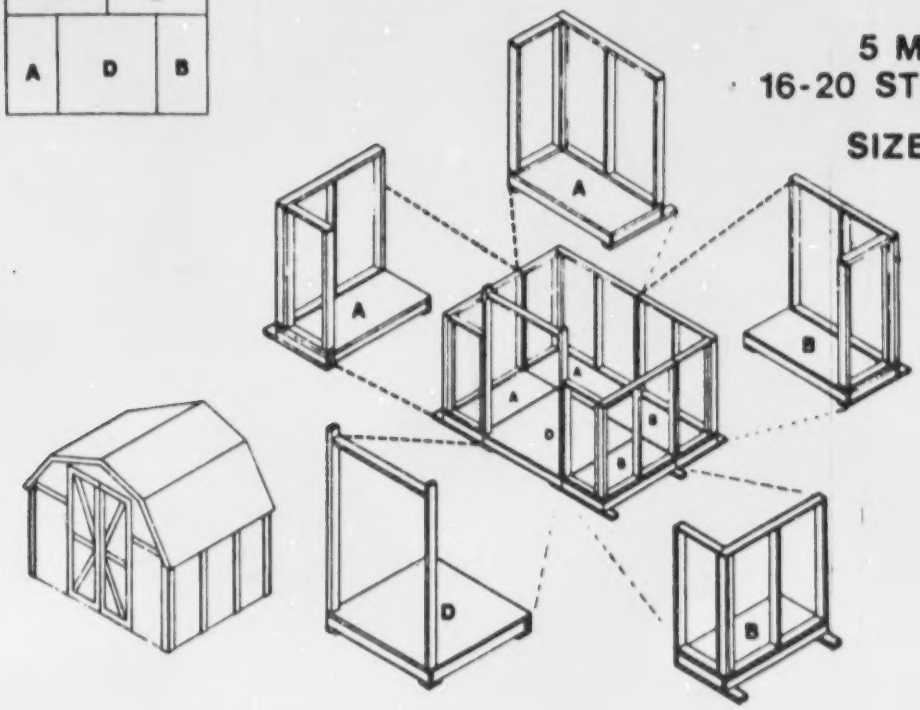
BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
28'	10' galvanized tin drip edge	___	___	___
16'	15 lb. 36" wide building felt	___	___	___
24	12" x 36" asphalt shingles	___	___	___
	6d nails	___	___	___
	8d nails	___	___	___
	6d galvanized nails	___	___	___
	8d galvanized nails	___	___	___
2 lb.	1/2" galvanized roofing nails	___	___	___
	16d nails	___	___	___

STRUCTURE # 3



5 MODULES
16-20 STUDENTS

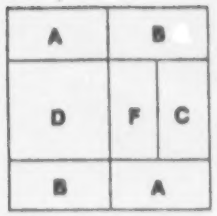
SIZE: 6' X 8'



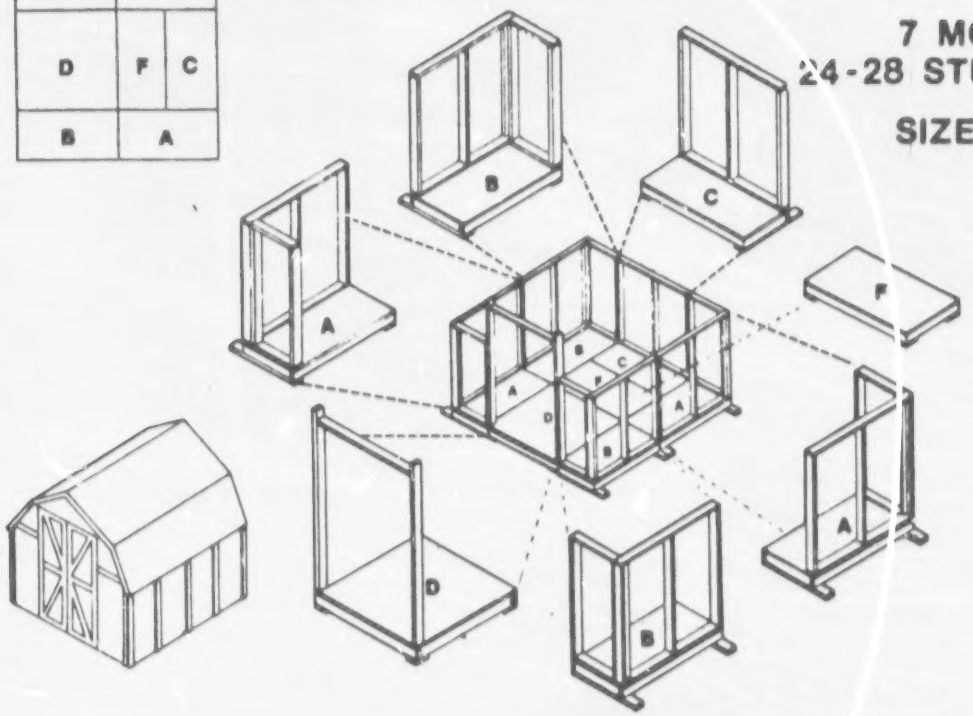
BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
2 1/2	1/4" x 4' x 8' plywood	___	___	___
5 3/4	1/2" x 4' x 8' plywood	___	___	___
6	3/4" x 1 1/2" x 8' pine	___	___	___
11	1" x 1 3/4" x 43 3/4"	___	___	___
4	1" x 2 3/4" x 47 1/4"	___	___	___
11	1" x 4" x 4'	___	___	___
2	1" x 4" x 6'	___	___	___
14	1" x 4" x 8'	___	___	___
6	1" x 4" x 10'	___	___	___
1	1" x 4" x 12'	___	___	___
10	2" x 4" x 4'	___	___	___
12	2" x 4" x 6'	___	___	___

BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
28	2 x 4' x 8'	___	___	___
1	2" x 4" x 12'	___	___	___
36'	10' galvanized tin drip edge	___	___	___
24'	15 lb. 36" wide building felt	___	___	___
36	12" x 36" asphalt shingles	___	___	___
	6d nails	___	___	___
	8d nails	___	___	___
	16d nails	___	___	___
	6d galvanized nails	___	___	___
	8d galvanized nails	___	___	___
2 1/2 lb	1/2" galvanized roofing nails	___	___	___

STRUCTURE # 4



7 MODULES
24-28 STUDENTS
SIZE: 8' X 8'

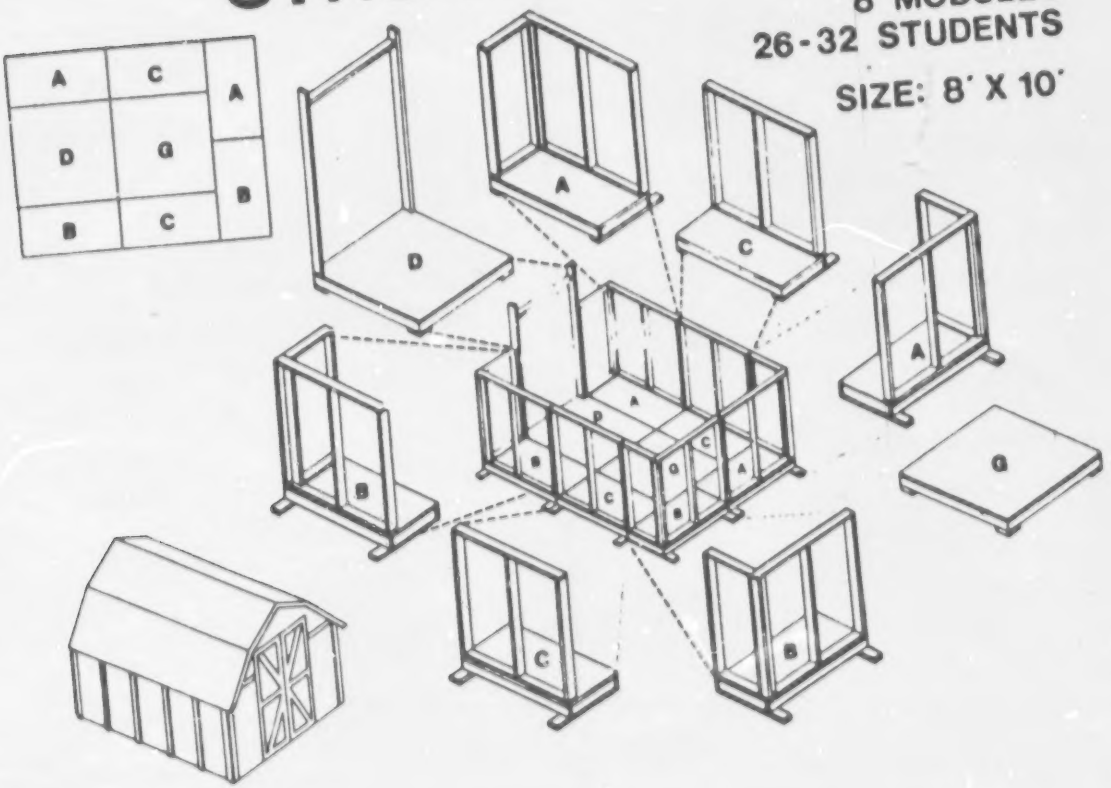


BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
3 1/4	1/4" x 4' x 9' plywood	___	___	___
7 1/2	1/2" x 4' x 8' plywood	___	___	___
6	3/4" x 1 1/2" x 8' pine	___	___	___
13	1" x 1 3/4" x 43 3/4"	___	___	___
4	1" x 2 3/4" x 47 1/4"	___	___	___
12	1" x 4" x 4'	___	___	___
4	1" x 4" x 6'	___	___	___
16	1" x 4" x 8'	___	___	___
5	1" x 4" x 10'	___	___	___
1	1" x 4" x 12'	___	___	___
10	2" x 4" x 4'	___	___	___

BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
15	2" x 4" x 6'	___	___	___
34	2" x 4" x 8'	___	___	___
1	2" x 4" x 12'	___	___	___
40'	10' galvanized tin drip edge	___	___	___
32'	15 lb. 36" wide building felt	___	___	___
48	12" x 36" asphalt shingles	___	___	___
	6d nails	___	___	___
	8d nails	___	___	___
	16d nails	___	___	___
	6d galvanized nails	___	___	___
	8d galvanized nails	___	___	___
3 1/2 lb.	1/2" galvanized roofing nails	___	___	___

STRUCTURE #5

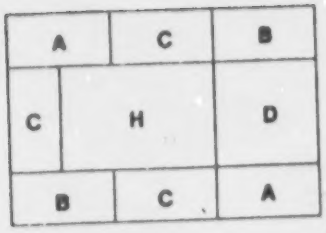
8 MODULES
26-32 STUDENTS
SIZE: 8' X 10'



BILL OF MATERIALS	NUMBER NEEDED	UNIT COST	TOTAL COST
4 1/4" x 4' x 8' plywood			
8 1/2" x 4' x 8' plywood			
6 3/4" x 1 3/4" x 8' pine			
15 1" x 1 3/4" x 43 3/4"			
4 1" x 2 3/4" x 47 1/4"			
12 1" x 4" x 4'			
4 1" x 4" x 6'			
18 1" x 4" x 8'			
6 1" x 4" x 10'			
1 1" x 4" x 12'			
7 2" x 4" x 4'			
17 2" x 4" x 6'			

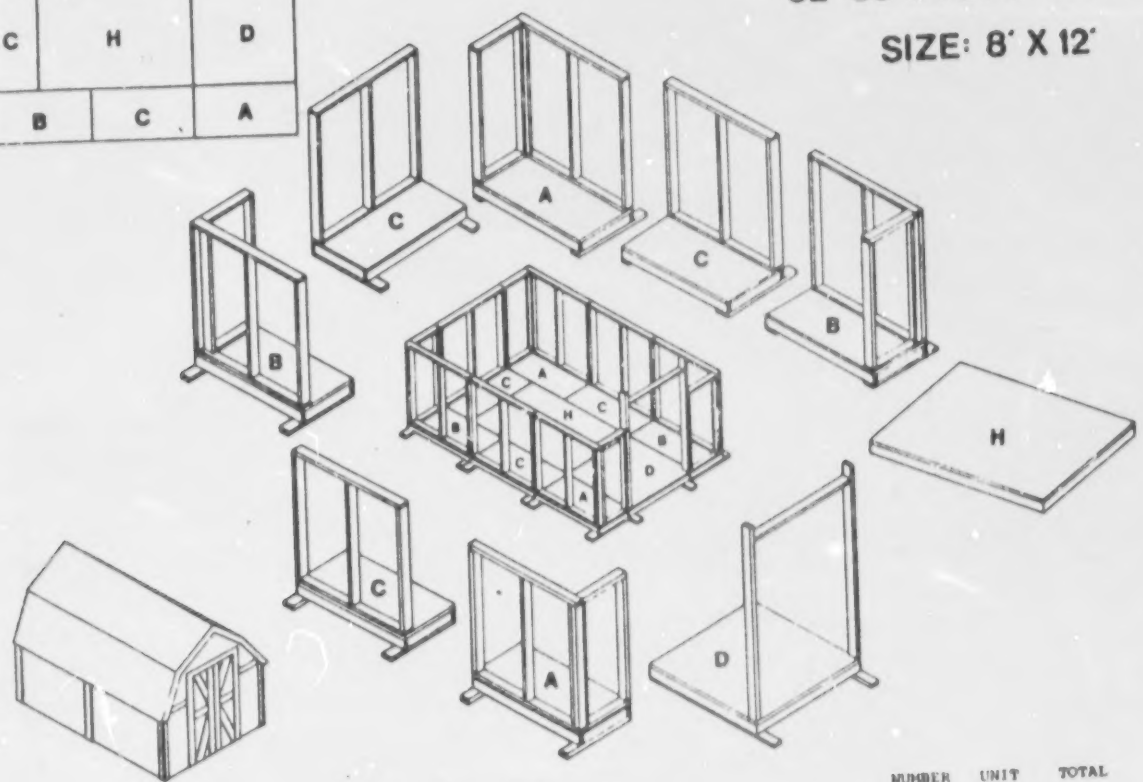
BILL OF MATERIALS	NUMBER NEEDED	UNIT COST	TOTAL COST
41 2" x 4" x 8'			
1 2" x 4" x 12'			
44' 10' galvanized tin drip edge			
40' 15 lb. 36" wide building felt			
60 12" x 36" asphalt shingles			
6d nails			
8d nails			
16d nails			
6d galvanized nails			
8d galvanized nails			
4 lb. 1/2" galvanized roofing nails			

STRUCTURE #6



9 MODULES
32-36 STUDENTS

SIZE: 8' X 12'



BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
4 1/2	1/4" x 4' x 8' plywood			
9	1/2" x 4' x 8' plywood			
6	3/4" x 1 1/2" x 8' pine			
17	1" x 1 3/4" x 47 3/4"			
4	1" x 3 3/4" x 47 1/4"			
14	1" x 4" x 8'			
4	1" x 4" x 6'			
11	1" x 4" x 8'			
7	1" x 4" x 10'			
3	1" x 4" x 12'			
7	2" x 4" x 4'			

BILL OF MATERIALS		NUMBER NEEDED	UNIT COST	TOTAL COST
19	2" x 4" x 6'			
44	2" x 4" x 8'			
1	2" x 4" x 12'			
48'	10' galvanized tin drip edge			
48'	15 lb. 36" wide building felt			
72	12" x 36" asphalt shingles			
	6d nails			
	8d nails			
	16d nails			
	6d galvanized nails			
	8d galvanized nails			
5 lb.	1/2" galvanized roofing nails			